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What is claimed is:

1	 A processor implemented data processing method comprising:
2	identifying a first plurality of regions within a first recursively
3	partitioned/nested geometric structure that correspond to a first plurality of
4	normalized multi-dimensional data of a first normalized multi-dimensional data
5	space, the first recursively partitioned/nested geometric structure being
6	corresponding to the first normalized multi-dimensional data space;
7	determining corresponding first graphing values for said first corresponding
8	regions within said first recursively partitioned/nested geometric structure
9	determined for said first normalized multi-dimensional data of said first normalized
10	multi-dimensional data space;
11	associating corresponding first visual attributes with said first corresponding
12	regions within said first recursively partitioned/nested geometric structure, based at
13	least in part on corresponding ones of said determined first graphing values; and
14	displaying said first recursively partitioned/nested geometric structure, visually

2. The method of claim 1, wherein each of said first normalized multi-dimensional data of said first normalized multi-dimensional data space comprises a plurality of relative coordinate values, and the method further comprises constructing a polynary string to represent each of said first normalized multi-dimensional data and its corresponding one of said first regions within said first recursively

differentiating said first corresponding regions based at least in part on

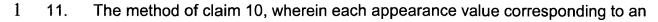
corresponding ones of said associated first visual attributes.



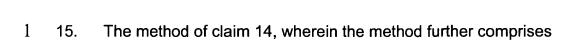
- 6 partitioned/nested geometric structure in accordance with the relative coordinate
- 7 values.
- 1 3. The method of claim 2, wherein said constructing of a polynary string to
- 2 represent each of said first normalized multi-dimensional data and its corresponding
- 3 one of said first regions within said first recursively partitioned/nested geometric
- 4 structure in accordance with the relative coordinate values comprises selecting a
- 5 symbol as the next symbolic member of the polynary string based on which of the
- 6 relative coordinate values is the current highest relative coordinate value.
- 1 4. The method of claim 3, wherein said constructing of a polynary string to
- 2 represent each of said first normalized multi-dimensional data and its corresponding
- 3 one of said first regions within said first recursively partitioned/nested geometric
- 4 structure in accordance with the relative coordinate values further comprises
- 5 reducing the highest relative coordinate value in by an amount (G), upon each
- 6 selection, and reducing the amount (G) after each reduction.
- 1 5. The method of claim 4, wherein the amount (G) initially equals 1 – F, and
- 2 thereafter reduced each time by $G^*(1 - F)$, where F equals (n - 1)/n, and n equals
- 3 the number of relative coordinate values.
- 1 6. The method of claim 2, wherein said determining of corresponding first
- graphic values comprises determining frequencies of occurrence of the various 2
- 3 polynary strings of said first normalized multi-dimensional data, and assigning the
- 4 determined frequencies of occurrence to the corresponding first regions within the



- 5 first recursively partitioned/nested geometric structure as the determined first
- 6 graphing values of the corresponding first regions.
- 1 7. The method of claim 1, wherein said determining of corresponding first
- 2 graphic values comprises assigning first output values corresponding to the first
- 3 normalized multi-dimensional data as the determined first graphing values of the
- 4 corresponding first regions within the first recursively partitioned/nested geometric
- 5 structure.
- 1 8. The method of claim 7, wherein said determining of corresponding first
- 2 graphic values further comprises computing said first output values.
- 1 9. The method of claim 8, wherein each of said first normalized multi-
- 2 dimensional data of said first normalized multi-dimensional data space comprises a
- 3 polynary string having a plurality of symbols, encoding a plurality of relative
- 4 coordinate values, and said computing of the first output values comprises
- 5 for each constituting symbols of a polynary string, summing one or more
- 6 appearance values corresponding to one or more appearances of the particular
- 7 symbol in the polynary string, and adding the sum to an average residual relative
- 8 coordinate value.
- 1 10. The method of claim 9, wherein each appearance value corresponding to an
- 2 appearance of a particular symbol is dependent on the position of the particular
- 3 appearance of the particular symbol in the polynary string.



- 2 appearance of a particular symbol is equal to a positional value associated with the
- 3 position of the particular appearance in the polynary string.
- 1 12. The method of claim 11, wherein
- 2 each positional value equals to $(1 F) \times F^{**}(k 1)$, and
- 3 the average residual relative coordinate value equals $(1 F) \times F^{**}K$,
- 4 where F equals (n 1)/n,
- 5 k denotes a position in a polynary string,
- 6 n equals the number of relative coordinate values, and
- 7 K equals the length of the polynary string.
- 1 13. The method of claim 2, wherein the method further comprises
- 2 receiving a first zooming specification comprising one or more of said
- 3 polynary string constituting symbols;
 - excluding a first subset of said first regions based at least in part on said
- 5 received first zooming specification; and
- 6 repeating said displaying for the remaining ones of said first regions in an
- 7 expanded manner.
- 1 14. The method of claim 13, wherein the method further comprises
- 2 receiving a second zooming specification comprising one or more additional
- 3 ones of said polynary string constituting symbols;
- 4 excluding a second subset of said remaining ones of said first regions based
- 5 at least in part on said received second zooming specification; and
- 6 repeating said displaying for the remaining ones of said first regions.



- restoring the remaining ones of said first regions to re-include said excluded second subset of said first regions; and
- 5 repeating said displaying for the remaining ones of said first regions.
- 1 16. The method of claim 13, wherein the method further comprises
 2 receiving an unzoom specification;
 3 restoring the remaining ones of said first regions to re-include said excluded
- 4 first subset of said first regions; and
- 5 repeating said displaying for said first regions.

receiving an unzoom specification;

- 1 17. The method of claim 1, wherein said associating comprises for each of said
- 2 first regions, associating a selected one of a plurality of symbols with the region
- 3 based at least in part on the determined graphing value of the region.
- 1 18. The method of claim 1, wherein said associating comprises for each of said
- 2 first regions, associating a selected one of a plurality of color attributes with the
- 3 region based at least in part on the determined graphing value of the region.
- 1 19. The method of claim 1, wherein said associating comprises for each of said
- 2 first regions, associating a selected one of a plurality of colored geometric primitives
- 3 with the region based at least in part on the determined graphing value of the region.



- 1 20. The method of claim 1, wherein said associating comprises for each of said
- 2 first regions, associating a selected blending of a plurality of colors with the region
- 3 based at least in part on contributions to the determined graphing value of the
- 4 region.
- 1 21. The method of claim 1, wherein said first regions correspond to all
- 2 constituting regions of the first recursively partitioned/nested geometric structure,
- 3 said first normalized multi-dimensional data are values of independent variables of a
- 4 function, and said first graphing values are corresponding values of a dependent
- 5 variable of the function.
 - 22. The method of claim 1, wherein the method further comprises
- 2 identifying a second plurality of regions within a second recursively
- 3 partitioned/nested geometric structure that correspond to a second plurality of
- 4 normalized multi-dimensional data of a second normalized multi-dimensional data
- 5 space, the second recursively partitioned/nested geometric structure being
- 6 corresponding to the second normalized multi-dimensional data space;
- 7 determining corresponding second graphing values for said second
- 8 corresponding regions within said second recursively partitioned/nested geometric
- 9 structure determined for said second normalized multi-dimensional data of said
- 10 second normalized multi-dimensional data space;
- associating corresponding second visual attributes with said second
- 12 corresponding regions within said second recursively partitioned/nested geometric
- structure, based at least in part on corresponding ones of said determined second
- 14 graphing values; and

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- displaying said second recursively partitioned/nested geometric structure,
 visually differentiating said second corresponding regions based at least in part on
 corresponding ones of said associated second visual attributes.
- 1 23. The method of claim 22, wherein said first and second recursively
- 2 partitioned/nested geometric structures are displayed in a manner such that both
- 3 recursively partitioned/nested geometric structures are visible concurrently.
- The method of claim 23, wherein each of said first and second normalized multi-dimensional data of said first and second normalized multi-dimensional data spaces comprises a polynary string having a plurality of symbols, encoding a plurality of relative coordinate values, the method further comprises
 - receiving a first zooming specification comprising one or more of said polynary string constituting symbols;
 - excluding a first subset of said first regions based at least in part on said received first zooming specification;
 - excluding a second subset of said second regions based at least part on the removed ones of said first regions; and
- repeating said displaying for the remaining ones of said first and second regions.
- 1 25. The method of claim 22, wherein said first and second normalized multi-
- 2 dimensional data are values of first and second input variables.

- 3 are values of corresponding output variables.
- 1 27. The method of claim 1, wherein the method further comprises computing a
- 2 location for a centroid for each of a plurality primitive elements of the geometric
- 3 structure.

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1 28. The method of claim 27, wherein coordinates (x_p, y_p) of the location of each

2 centroid is computed as follows:

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$$Xp = Xc + R * \sum_{k=1}^{K} V(N,k) * C(N,m[Lk])$$

4
$$Yp = Yc + R * \sum_{k=1}^{K} V(N,k) * S(N,m[Lk])$$

5 where:

6 (X_{c,} Y_c) are coordinate values of the geometric structure's centroid;

R is a radius extending from the geometric structure's centroid to an outermost vertex of the geometric structure;

9 V(N, k) is $w^*(1 - w)^{**}(k - 1)$ where $w = 1/(1 + \sin(\pi/N))$;

10 m[L_k] is outer vertex number (1, 2, ..., N) assigned to the kth symbol appearing in a corresponding polynary string;

12 $C(N, m[L_k]) = cosine(a^* \pi)$; and

13 $S(N, m[L_k]) = sine(a^* \pi) [where a = (5^*N - 4^*m[L_k])/(2^*N)].$

1 29. The method of claim 28, wherein the K values of V(N, k) are computed once

2 responsive to a specification of N.



- 1 30. The method of claim 28, wherein at least the N values of $C(N, m[L_k])$ or the N
- 2 values of S(N, m[Lk]) are computed once responsive to a specification of N.
- 1 31. A processor implemented data processing method for generating a polynary
- 2 string representation for an entity defined by n relative coordinate values, n being an
- 3 integer, comprising:
- 4 associating n symbolic representations with said n relative coordinate values;
- 5 and
- 6 selecting the symbolic representation corresponding to the highest relative
- 7 coordinate value as the first constituting member of the polynary string
- 8 representation.
- 1 32. The method of claim 31, wherein the method further comprises
- 2 computing a constant value (F) by dividing (n 1) by n; and
- 3 computing a variable value (G) by subtracting F from 1;
- 4 subtracting G from the current highest relative coordinate value; and
- 5 selecting the symbolic representation corresponding to the current highest
- 6 relative coordinate value as the next constituting member of the polynary string
- 7 representation.
- 1 33. The method of claim 32, wherein the method further comprises
- 2 multiplying the current value of G by F;
- 3 subtracting G from the current highest relative coordinate value; and
- 4 selecting the symbolic representation corresponding to the current highest
- 5 relative coordinate value as the next constituting member of the polynary string
- 6 representation.



- 2 said multiply, subtracting and selecting operations set forth in claim 29.
- 1 35. The method of claim 31, wherein said symbolic representation comprises a
- 2 letter.
- 1 36. The method of claim 31, wherein said symbolic representation comprises a
- 2 special character.
- 1 37. A processor implemented data processing method for generating a relative
- 2 coordinate value for an constituting variable of an entity, the entity being
- 3 represented by a polynary string representation having a plurality of symbolic
- 4 members representing the constituting variables, the method comprising:
- 5 determining appearance positions of appearance instances of the symbolic
- 6 members in said polynary string representation;
- summing positional values corresponding to the appearance instances of the
- 8 symbolic members in said polynary string representation; and
- 9 adding the sum to an average residual relative coordinate value.
- 1 38. The method of claim 37, wherein
- 2 each positional value equals to $(1 F) \times F^{**}(k 1)$, and
- 3 the average residual relative coordinate value equals $(1 F) \times F^{**}K$,
- 4 where F equals (n 1)/n,
- 5 n equals the number of coordinate values,
- 6 k denotes a position in the polynary string representation; and

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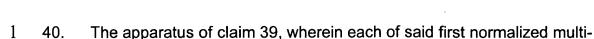
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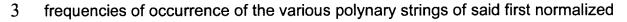
39.	An apparatus comprising:
	storage medium having stored therein programming instructions designed to
ena	ble the apparatus to
	identify a first plurality of regions within a first recursively
	partitioned/nested geometric structure that correspond to a first
	plurality of normalized multi-dimensional data of a first normalized
	multi-dimensional data space, the first recursively partitioned/nested
	geometric structure being corresponding to the first normalized multi-
	dimensional data space,
	determine corresponding first graphing values for said first corresponding
	regions within said first recursively partitioned/nested geometric
	structure determined for said first normalized multi-dimensional data of
	said first normalized multi-dimensional data space;
	associate corresponding first visual attributes with said first corresponding
	regions within said first recursively partitioned/nested geometric
	structure, based at least in part on corresponding ones of said
	determined first graphing values, and
	display said first recursively partitioned/nested geometric structure,
	visually differentiating said first corresponding regions based at least in
	part on corresponding ones of said associated first visual attributes;
	and
	at least one processor coupled to the storage medium to execute the

programming instructions.



- 2 dimensional data of said first normalized multi-dimensional data space comprises a
- 3 plurality of relative coordinate values, and the programming instructions are further
- 4 designed to enable the apparatus to construct a polynary string to represent each of
- 5 said first normalized multi-dimensional data and its corresponding one of said first
- 6 regions within said first recursively partitioned/nested geometric structure in
- 7 accordance with the relative coordinate values.
- 1 41. The apparatus of claim 40, wherein said programming instructions are
- 2 designed to enable the apparatus to perform said constructing of a polynary string
- 3 by selecting a symbol as the next symbolic member of the polynary string based on
- 4 which of the relative coordinate values is the current highest relative coordinate
- 5 value.
- 1 42. The apparatus of claim 41, wherein said programming instructions are further
- 2 designed to enable the apparatus to perform said constructing of a polynary string
- 3 by reducing the highest relative coordinate value in by an amount (G), upon each
- 4 selection, and reducing the amount (G) after each reduction.
- 1 43. The apparatus of claim 42, wherein said programming instructions are
- 2 designed to enable the apparatus to set the amount (G) initially to 1 F, and
- 3 thereafter reduced each time by $G^*(1 F)$, where F equals (n 1)/n, and n equals
- 4 the number of relative coordinate values.
- 1 44. The apparatus of claim 40, wherein said programming instructions are
- 2 designed to enable the apparatus to perform said determining by determining





- 4 multi-dimensional data, and assigning the determined frequencies of occurrence to
- 5 the corresponding first regions within the first recursively partitioned/nested
- 6 geometric structure as the determined first graphing values of the corresponding first
- 7 regions.
- 1 45. The apparatus of claim 39, wherein said programming instructions are
- 2 designed to enable the apparatus to perform said determining by assigning first
- 3 output values corresponding to the first normalized multi-dimensional data as the
- 4 determined first graphing values of the corresponding first regions within the first
- 5 recursively partitioned/nested geometric structure.
- 1 46. The apparatus of claim 45, wherein said programming instructions are further
- 2 designed to enable the apparatus to perform said determining by computing said
- 3 first output values.
- 1 47. The apparatus of claim 46, wherein each of said first normalized multi-
- 2 dimensional data of said first normalized multi-dimensional data space comprises a
- 3 polynary string having a plurality of symbols, encoding a plurality of relative
- 4 coordinate values, and said programming instructions are designed to enable the
- 5 apparatus to perform said computing by
- 6 summing one or more appearance values corresponding to one or more
- 7 appearances of the particular symbol in a polynary string, and adding the sum to an
- 8 average residual relative coordinate value, and
- 9 repeating said summing and adding for each constituting symbols of the
- 10 polynary string.



- 2 an appearance of a particular symbol is dependent on the position of the particular
- 3 appearance of the particular symbol in the polynary string.
- 1 49. The apparatus of claim 48, wherein each appearance value corresponding to
- 2 an appearance of a particular symbol is equal to a positional value associated with
- 3 the position of the particular appearance in the polynary string.
- 1 50. The apparatus of claim 49, wherein
- each positional value equals to $(1 F) \times F^{**}(k 1)$, and
- 3 the average residual relative coordinate value equals $(1 F) \times F^{**}K$,
- 4 where F equals (n 1)/n,
- 5 k denotes a position in a polynary string,
- 6 n equals the number of relative coordinate values, and
- 7 K equals the length of the polynary string.
- 1 51. The apparatus of claim 40, wherein said programming instructions are further
- 2 designed to enable the apparatus to
- 3 receive a first zooming specification comprising one or more of said polynary
- 4 string constituting symbols;
- 5 exclude a first subset of said first regions based at least in part on said
- 6 received first zooming specification; and
- 7 repeat said displaying for the remaining ones of said first regions in an
- 8 expanded manner.

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1	52.	The apparatus of claim 51, wherein said programming instructions are further
2	desiç	gned to enable the apparatus to
3		receive a second zooming specification comprising one or more additional
4	ones	of said polynary string constituting symbols;
5		exclude a second subset of said remaining ones of said first regions based at
6	least	in part on said received second zooming specification; and
7		repeat said displaying for the remaining ones of said first regions.
1	53.	The apparatus of claim 52, wherein said programming instructions are

- designed to enable the apparatus to
 receive an unzoom specification;
 restore the remaining ones of said first regions to re-include said excluded
 second subset of said first regions; and
 repeat said displaying for the remaining ones of said first regions.
 - 54. The apparatus of claim 51, wherein said programming instructions are further designed to enable the apparatus to receive an unzoom specification; restore the remaining ones of said first regions to re-include said excluded
- restore the remaining ones of said first regions to re-include said excluded first subset of said first regions; and repeat said displaying for said first regions.
- The apparatus of claim 39, wherein said programming instructions are designed to enable the apparatus to perform said associating by associating, for each of said first regions, a selected one of a plurality of symbols with the region based at least in part on the determined graphing value of the region.

- 1 56. The apparatus of claim 39, wherein said programming instructions are
- 2 designed to enable the apparatus to perform said associating by associating, for
- 3 each of said first regions, a selected one of a plurality of color attributes with the
- 4 region based at least in part on the determined graphing value of the region.
- 1 57. The apparatus of claim 39, wherein said programming instructions are
- 2 designed to enable the apparatus to perform said associating by associating, for
- 3 each of said first regions, a selected one of a plurality of colored geometric
- 4 primitives with the region based at least in part on the determined graphing value of
- 5 the region.
- 1 58. The apparatus of claim 39, wherein said programming instructions are
- 2 designed to enable the apparatus to perform said associating by associating, for
- ach of said first regions, a selected blending of a plurality of colors with the region
- 4 based at least in part on contributions to the determined graphing value of the
- 5 region.
- 1 59. The apparatus of claim 39, wherein said first regions correspond to all
- 2 constituting regions of the first recursively partitioned/nested geometric structure,
- 3 said first normalized multi-dimensional data are values of independent variables of a
- 4 function, and said first graphing values are corresponding values of a dependent
- 5 variable of the function.
- 1 60. The apparatus of claim 39, wherein said programming instructions are further
- 2 designed to enable the apparatus to

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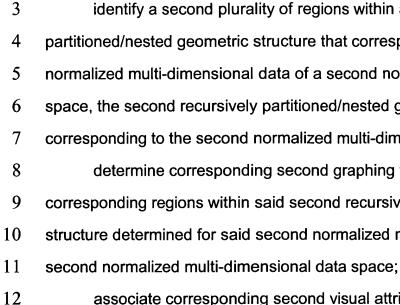
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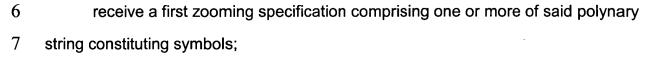


identify a second plurality of regions within a second recursively
partitioned/nested geometric structure that correspond to a second plurality of
normalized multi-dimensional data of a second normalized multi-dimensional data
space, the second recursively partitioned/nested geometric structure being
corresponding to the second normalized multi-dimensional data space;
determine corresponding second graphing values for said second
corresponding regions within said second recursively partitioned/nested geometric
structure determined for said second normalized multi-dimensional data of said

associate corresponding second visual attributes with said second corresponding regions within said second recursively partitioned/nested geometric structure, based at least in part on corresponding ones of said determined second graphing values; and

display said second recursively partitioned/nested geometric structure, visually differentiating said second corresponding regions based at least in part on corresponding ones of said associated second visual attributes.

- 61. The apparatus of claim 60, wherein said first and second recursively partitioned/nested geometric structures are displayed in a manner such that both recursively partitioned/nested geometric structures are visible concurrently.
- 62. The apparatus of claim 61, wherein each of said first and second normalized multi-dimensional data of said first and second normalized multi-dimensional data spaces comprises a polynary string having a plurality of symbols, encoding a plurality of relative coordinate values, said programming instructions are further designed to enable the apparatus to



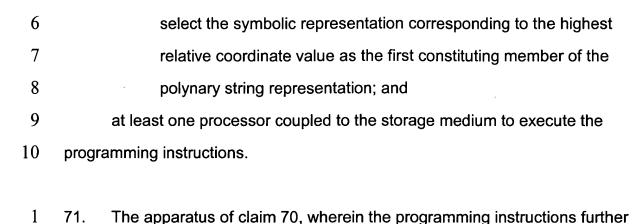
- exclude a first subset of said first regions based at least in part on said received first zooming specification;
- exclude a second subset of said second regions based at least part on the removed ones of said first regions; and
- repeat said displaying for the remaining ones of said first and second regions.
- 1 63. The apparatus of claim 60, wherein said first and second normalized multi-2 dimensional data are values of first and second input variables.
- 1 64. The apparatus of claim 60, wherein said first normalized multi-dimensional
- 2 data are values of input variables, and said second normalized multi-dimensional
- 3 data are values of corresponding output variables.
- 1 65. The apparatus of claim 39, wherein said apparatus is a selected one of a
- 2 palm sized processor based device, a notebook computer, a desktop computer, a
- 3 set-top box, a single processor server, a multi-processor server, and a collection of
- 4 coupled servers.
- 1 66. The apparatus of claim 37, wherein said programming instructions are further
- 2 designed to compute a location for a centroid for each of a plurality of primitive
- 3 elements of the geometric structure.
- 1 67. The apparatus of claim 66, wherein said programming instructions are
- 2 designed to compute coordinates (x_p, y_p) of the location of each centroid as follows:

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$$Yp = Yc + R * \sum_{k=1}^{K} V(N,k) * S(N,m[Lk])$$

- 5 where:
- 6 (X_{c,} Y_c) are coordinate values of the geometric structure's centroid;
- 7 R is a radius extending from the geometric structure's centroid to an
- 8 outermost vertex of the geometric structure;
- 9 V(N, k) is $w^*(1 w)^{**}(k 1)$ where $w = 1/(1+\sin(\pi/N))$;
- 10 m[L_k] is outer vertex number (1, 2, ..., N) assigned to the kth symbol
- appearing in a corresponding polynary string;
- 12 $C(N, m[L_k]) = cosine(a^* \pi);$ and
- 13 $S(N, m[L_k]) = sine(a^* \pi) [where a = (5^*N 4^*m[L_k])/(2^*N)].$
 - 1 68. The apparatus of claim 67, wherein said programming instructions are
- designed to compute the K values of V(N, k) once responsive to a specification of N.
- 1 69. The method of claim 67, wherein said programming instructions are designed
- 2 to compute at least the N values of $C(N, m[L_k])$ or the N values of $S(N, m[L_k])$ once
- 3 responsive to a specification of N.
- 1 70. An apparatus comprising
- 2 storage medium having stored therein programming instructions designed to
- 3 enable the apparatus to
- 4 associate n symbolic representations with said n relative coordinate
- 5 values, and

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- enable the apparatus to
 compute a constant value (F) by dividing (n 1) by n; and
 compute a variable value (G) by subtracting F from 1;
 subtract G from the current highest relative coordinate value; and
 select the symbolic representation corresponding to the current highest
 relative coordinate value as the next constituting member of the polynary string
 representation.
 - 72. The apparatus of claim 71, wherein the programming instructions further enable the apparatus to multiply the current value of G by F; subtract G from the current highest relative coordinate value; and
- select the symbolic representation corresponding to the current highest relative coordinate value as the next constituting member of the polynary string representation.
- 73. The apparatus of claim 72, wherein the programming instructions further enable the apparatus to repeat said multiply, subtracting and selecting operations set forth in claim 64.

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1	74.	The apparatus of claim 70, wherein said symbolic representation comprises a	
2	letter		
1	7.5	The composition of alaims 70 to be units and completion accordations according	
1	75.	The apparatus of claim 70, wherein said symbolic representation comprises a	
2	spec	ial character.	
1	76.	The apparatus of claim 70, wherein said apparatus is a selected one of a	
2	palm sized processor based device, a notebook computer, a desktop computer, a		
3	set-top box, a single processor server, a multi-processor server, and a collection of		
4	coupled servers.		
1	77.	An apparatus comprising:	
2		storage medium having stored therein a plurality of programming instructions	
3	designed to enable the apparatus to		
4		determine appearance positions of appearance instances of symbolic	
5		members of a polynary string representation of an entity having a	
6		number of constituting variables, the symbolic members being	
7		corresponding to the constituting variables,	
8		sum positional values corresponding to the appearance instances of the	
9		symbolic members in said polynary string representation, and	
10		add the sum to an average residual relative coordinate value; and	
11		at least one processor coupled to the storage medium to execute the	
12	progr	ramming instructions.	

The apparatus of claim 77, wherein

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- 2 each positional value equals to $(1 F) \times F^{**}(k 1)$; and
- 3 the average residual relative coordinate value equals $(1 F) \times F^{**}K$,
- 4 where F equals (n 1)/n,
- n equals the number of coordinate values,
- 6 k denotes a position in the polynary string representation; and
- 7 K denotes the length of the polynary string.
- 1 79. The apparatus of claim 77, wherein said apparatus is a selected one of a
- 2 palm sized processor based device, a notebook computer, a desktop computer, a
- 3 set-top box, a single processor server, a multi-processor server, and a collection of
- 4 coupled servers.